Space Weather Technical Forecast

Issued on Saturday, 20 August 2022 at 13:28 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1/G2 Minor Geomagnetic Storm possible mainly day 1 and day 3. R1 risk waning.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low with only C-class flares observed from AR3078. This sunspot showed apparent decay, losing notable penumbra and some visible spots, but perhaps this was in part due to the change in viewing angle as it approached the southwest limb. This produced a C6.7 at 19/2031UTC with a Type-II radio burst observed, however any CME is not Earth-directed. The other six sunspots populating the Earth-facing disc were less complex, with many simple dipoles or else monopoles. No other Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR and ACE at L1, was symptomatic of both a fast wind regime from CH14/-, with a CME arrival at 19/1702UTC. The solar wind speed rose from Elevated to Strong with the advent of the CME, from around 550km/s to peak around 700km/s before easing back to near 500km/s. The associated solar wind density peaked around 12 ppcc with the CME arrival, before gradually declining. The interplanetary magnetic field strength (IMF), Bt increased from 5nT to 12nT with the CME arrival with the Bz variable, mainly between -5nT and +5nT, but with a period of around -5 nT to -10nT with the CME arrival (19/1700-2000 UTC). The phi angle was mostly negative (towards the Sun) but with a distinct and smooth rotation visible from 20/0300 UTC. Geomagnetic activity rose from Quiet to Active with a G1/Minor Storm (Kp5) between 19/1800-2100 UTC due to the CME arrival, then declined after 20/0300 UTC to be Quiet to Unsettled.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured by GOES16, was at background. The high energy electron flux (greater than 2 MeV) rose to peak 2100pfu at 19/1735UTC, before dropping out with the CME arrival from around 19/1900 UTC. Flux recovered moderate levels on the 20th. The 24-hour integrated electron fluence was below the Active threshold, but with a rising trend also evident and with an observed value of 5.2e7 integrated pfu at 20/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be Low to Very Low, with AR3078 likely declining as it approaches the southwest limb.

Solar Wind / Geomagnetic Activity: The geomagnetic forecast is low confidence throughout, largely the result of the sheer number of mostly minor CMEs from AR3078, with some cases of glancing incidence possible. These are most likely either later on day 1 (20th) or day 3 (21st). Otherwise CH14 fast wind is expected to gradually ease, but with a further enhancement possible day 4 (22nd). Geomagnetic activity is expected to be Quiet to Unsettled for much of the period, but with further spells of Active to G1 Minor Storms due to any CME glances, mainly late day 1 (20th) and later day 3 (22nd) into day 4 (23rd). These will also give a slight chance for G2/Moderate storms.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) will most likely remain at Background levels. High energy electron flux should show an upward

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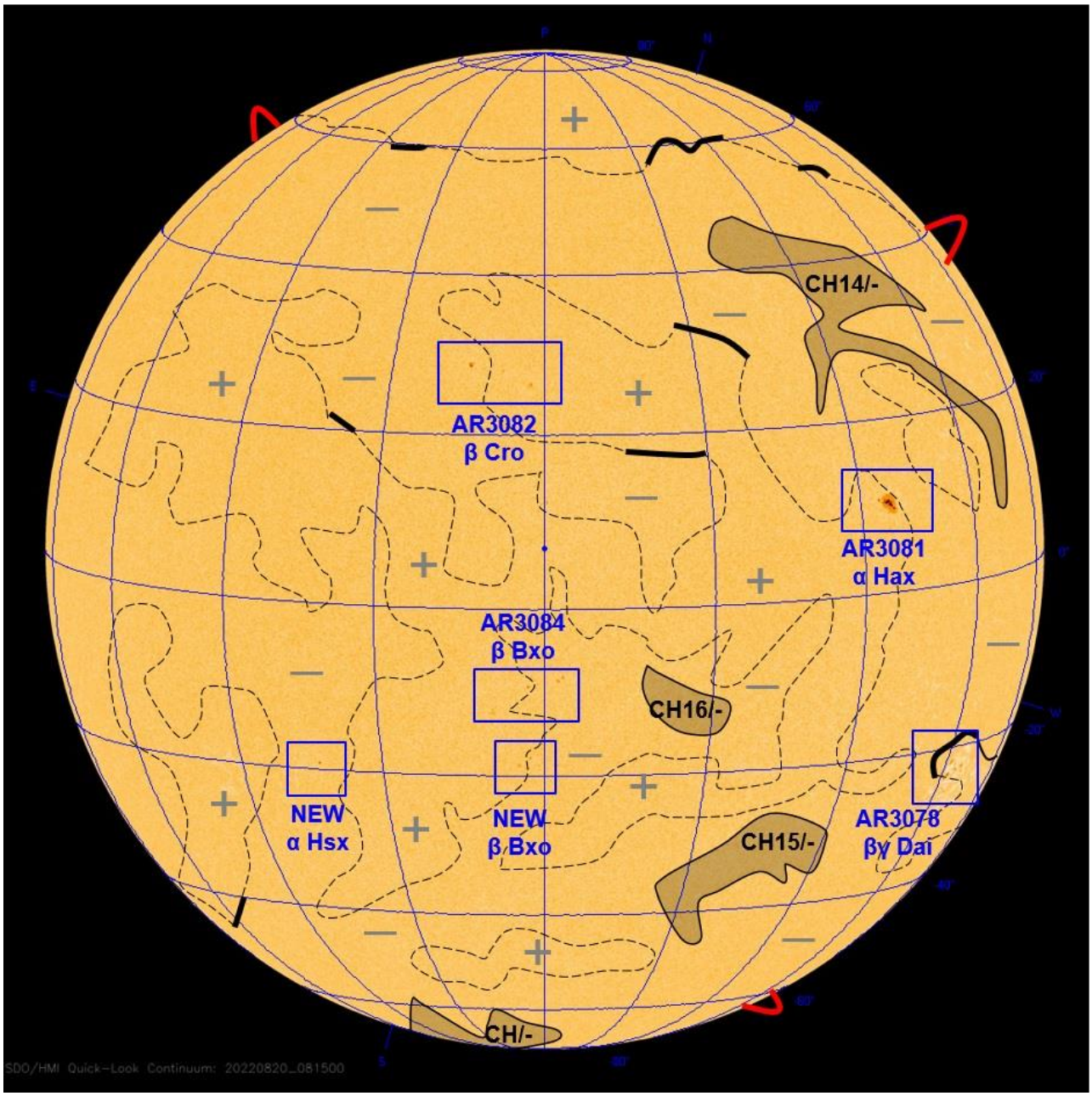
tendency in the period, the result of reaction to the fast wind from coronal hole 14, albeit tempered by any CME arrivals, which lower the confidence in the forecast. This may give Active 24 hr fluence at times, most likely day 2 and 3 (21st and 22nd).

Figure 1. Solar Analysis Valid 20/0800.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The geomagnetic forecast is low confidence throughout, due to the number of mostly minor CMEs from AR3078, with amalgamation of these likely and some cases of glancing incidence still possible. The main period of risk is during the rest of day 1 (20th), and with a further glance perhaps indicated later on day 3 (22nd), into day 4 (23rd). This is an updated CME analysis, of one that was previous forecast to glance on day 4 (23rd). Any CME arrival will bring a risk of G1/Minor Storms, and a slight chance of G2/Moderate storms.

STEREO A's solar wind recently declined, implying that the fast wind from CH14 at Earth is also expected to decline day 2 (21st). The following coronal hole, CH16 is not a persistent feature on the disc, with most likely arrival on day 4 (23rd) or just beyond the period on day 5 (24th). This is supported by MOSWOC enlil, which has been verifying well recently, providing moderate confidence in the coronal hole aspect of the forecast

Geomagnetic activity is expected to be Quiet to Unsettled for much of the period, but with further spells of Active to G1 Minor Storms due to any CME glances, mainly late day 1 (20th) and later day 3 (22nd) into day 4 (23rd). These will also give a slight chance for G2 Moderate storms.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	Yes	30	10	30	20
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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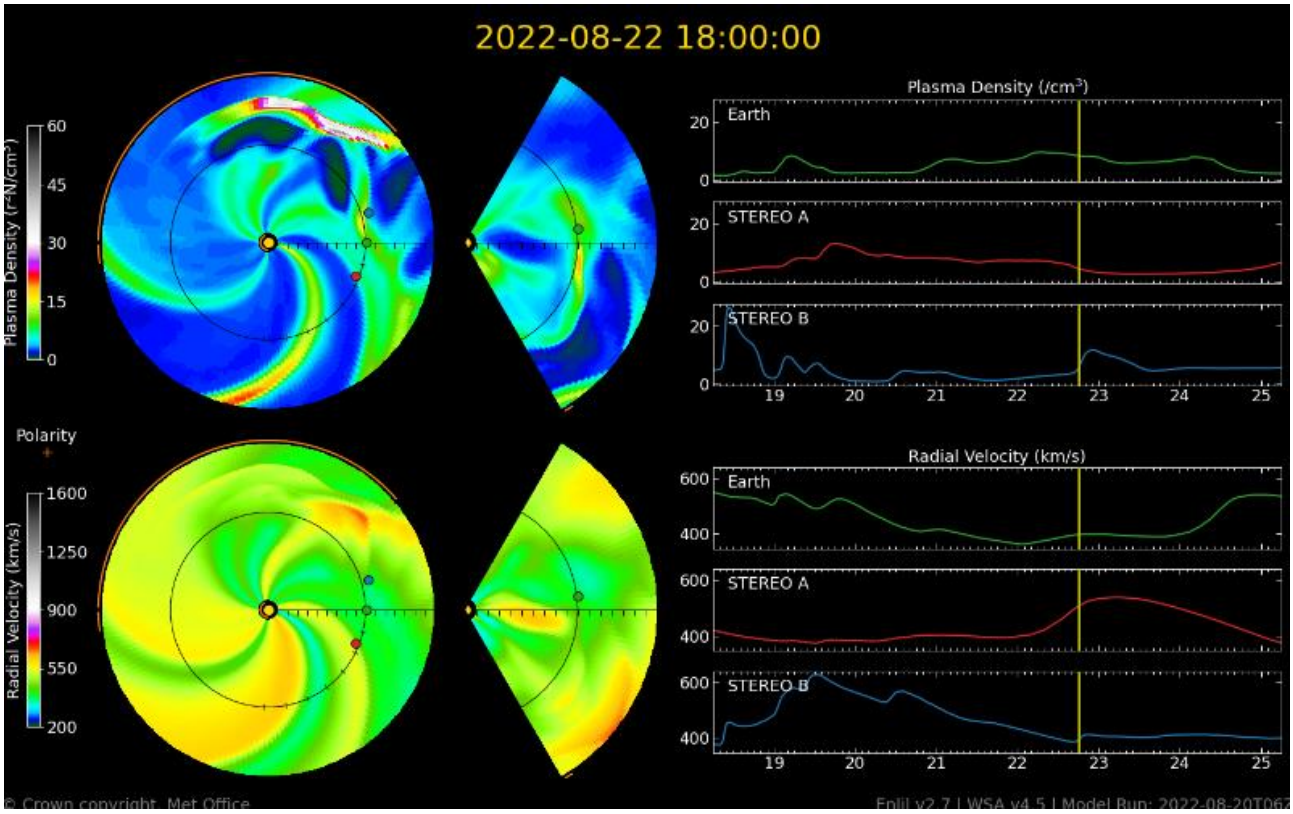
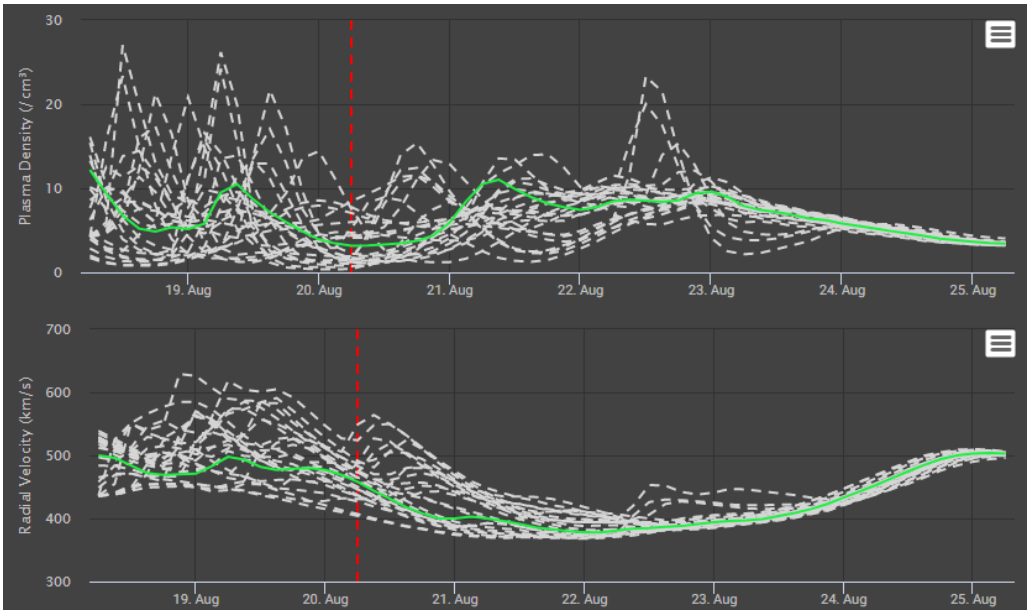
Figure 2: ENLIL and Ensemble





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Radio Blackouts - X-Ray Flares:

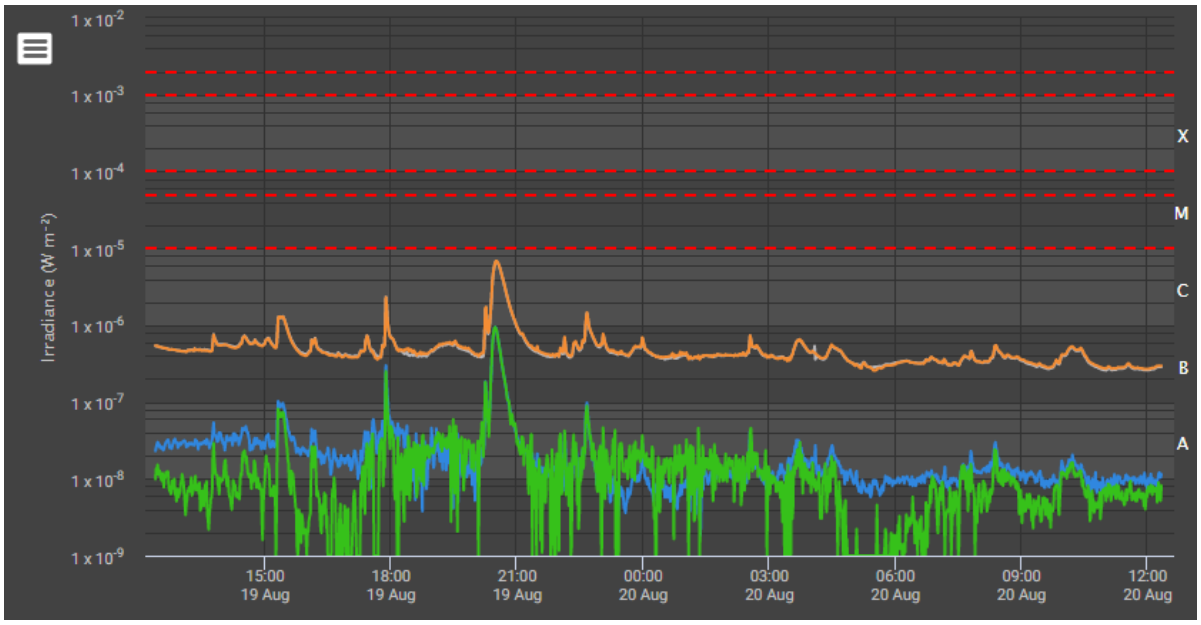
Solar activity is currently Low, with the most notable flare a long period C6.7 from AR3078 Dai/Beta-gamma in the southwest. This region has been the source of a number of M-flares over the previous week, and the main source of activity on the disc. During the last 24 hours, the region has both approached the southwest limb resulting in limited viewing, but also weakened with the number and strength of any flare activity declining. This is supported by the reducing f10.7 (Penticton) flux, having fallen from 117 sfu on the 18th to 105 sfu on the 19th.

There are a total of six active regions on the disc, however they are generally small and simple. AR3081 is the only other region of reasonable areal extent, but is currently a small and stable unipolar Hax/alpha spot.

Solar Activity is expected to be Low to Very Low, with a slight and decreasing chance of rising to Moderate due to any M-flaring, primarily from AR3078.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	15	10	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES 16/17 X-ray Flux



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 is at background, with any recent very slight enhancement having eased. There remains a very slight chance of further enhancement due to the location of weakening AR3078 in the southwest.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	2	2	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux as observed at GOES-16 has shown a response to both the current fast wind from CH14, but also the successive CMEs, with effects combining to make the electron forecast both volatile and of relatively low confidence.

In the absence of any CMEs, flux levels were expected to rise to be mostly high as the CH14 fast wind eased. However, recent arrival resulted in observed flux dropping out from High levels, to background, before recovering to Moderate at time of issue. A recovery in values is likely through day 1 and day 2 (20th and 21st), although with the potential for further glancing CME impacts, this is low confidence until later day 2. The magnitude of the recovery remains very low confidence however with Moderate to High flux likely. A further drop out in values is possible later day 3 (22nd) from any CME arrival, and if this doesn't occur, later day 4 (23rd) from the arrival of any CIR ahead of CH16.

Overall, the volatile nature of the flux forecast means that the associated 24 hour fluence forecast is low confidence. This most likely rising to around the Active threshold, perhaps rising just above at times, most likely day 2 and 3 (21st and 22nd). REFM suggests a more definitive rise, however this doesn't account for recent CME arrival, and any subsequent ones that may occur. This is likely giving poor guidance as a result.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	40	60	60	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	5	5	1

Figure 4: GOES-16 >2MeV Electron Flux and associated fluence with REFM and persistence.

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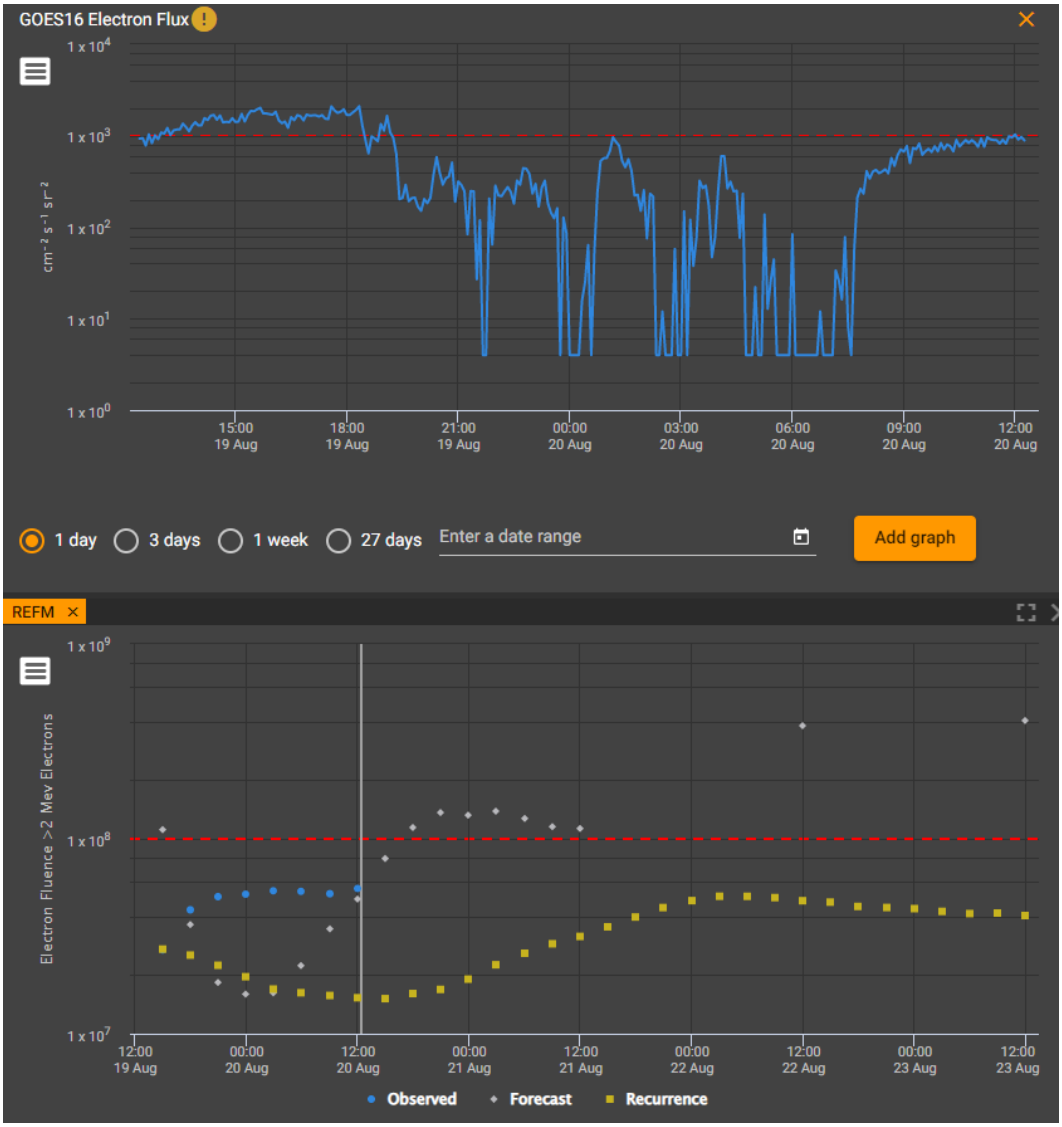

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